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(54) WASHING MACHINE

(71) We, ETABLISSEMENTS HOUDAILLE-LELAURAIN, a Société Anonyme organised and existing under the laws of France, of 8 rue Voltaire, Montreuil-sous-Bois, 93100, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a washing machine having a tub supported by a plurality of combined damping and suspension devices.

Suspension devices for tubs of washing machines are known which damp the oscillations of the tubs of washing machines. An example of such a device is shown in French Patent No. 1,289,955.

Moreover, it is known to use such suspension devices, operating by the action of springs or elastomeric sections (combined or not with damping means) in pairs (in accordance with British Patent No. 807,990) or in threes (in accordance with French Patent No. 1,163,015, French Patent No. 1,267,667, and British Patent No, 836,416). The aforesaid French Patent No. 1,289,955 has limited itself to claiming essentially a special control of such structures, to realise there an adaptation variable as a function of the state of vibration of the group of the tub.

This adaptation has remained more curious than effective, because of the complexity of the means used and thus has remained without industrial development.

The present invention provides a washing machine having a tub supported by a plurality of combined damping and suspension devices extending between the tub and other structure of the machine, each said device being telescopic and including a compression spring, one end of which abuts a cap which engages a friction member, the cap and friction member having complementary tapered surfaces abutting so that when the spring urges the cap against the friction member said tapered surfaces co-act to urge the friction member into engagement with an adjacent surface to damp telescoping movement of the device.

In the washing machine of the invention, therefore, each combined suspension and damping device includes friction member which is urged against another surface of the device by the tapered surfaces. This arrangement effectively counteracts the effects of wear on the friction member and also ensures that only the compression stroke of the device is damped and not the expansion stroke.

The combined suspension and damping devices of the device of the invention can be produced simply and economically from a relatively small number of parts.

The base, i.e. tub-remote, portion of each suspension and damping device can be articulatedly connected to structure of the washing machine by a ball-and-socket joint, or a cylindrical hub or stem.

Preferably the base attachment of each device is interchangeable with those having an eye or screw. Further, one or more of the devices can be provided with means for damping oscillations transversely of its or their longitudinal axis or axes.

The friction forces are conveniently produced by a coating of flocked textile fibres which are resistant to wear.

The invention will be described further, by way of example, with reference to the accompanying drawings, wherein:—

Fig. 1 is a diagrammatic fragmentary horizontal cross-sectional view of a washing machine showing one of a plurality of combined damping and suspension devices supporting a tube thereof;

Fig. 2 is a partial longitudinal section, in elevation, of a lower part of a combined damping and suspension device of a washing

machine of the present invention;

Fig. 3 is a partial longitudinal section, in elevation, of a modified form of combined damping and suspension device, having an upper screw attachment;

Fig. 4 is a partial longitudinal section, in elevation, of a further modified embodiment of combined damping and suspension device;

Fig. 5 is a longitudinal partial section taken on the line A—A of Fig. 6;

Fig. 6 is a profile view of a friction damping member;

Fig. 7 is a partial longitudinal section showing how an end portion of one of the aforesaid combined damping and suspension devices for a washing machine tub can have a screw attachment;

Fig. 8 is an elevation (with partial section) showing how a base portion of one of the aforesaid damping and suspension devices for a washing machine tub can be simplified;

Fig. 9 is a plan view, with section along the line B—B of Fig. 8;

Fig. 10 is an elevation of a rear half of an articulation attachment complementary to the base of the device of Figs. 8 and 9;

Fig. 11 is a cross-section transversely of the plane of the view of Fig. 10; and

Fig. 12 is a partial schematic section of a modification of an end attachment of the type shown in Fig. 7.

Fig. 1 shows, schematically, a part of a washing machine and one of a plurality of combined damping and suspension devices supporting a tub thereof. Fig. 2 shows one such device 3 having the basic combination of a helical compression spring 1, co-axial with a cylindrical rod 2 (here tubular) whose upper end (not shown) is provided with a standard attachment, or, better, an attachment of the kind designated by numeral 4 in Fig. 3. At the base of the device 3, i.e. that end remote from the tub, the rod 2 is retained by its splayed out rim 5, in a part-spherical member 8, engaging a part-spherical member 8, engaging a part-spherical socket 6 connected to the top of a support 7 which is rigidly fixed to a frame or body of the machine by a bolt.

At the top of the support 7, the member 8 has internal ribs 9, and external ribs 10, and is advantageously made by moulding in plastics material (for example superpolyamide) to ensure the guidance and the sliding of the cylindrical rod 2. The part-spherical portion of the member 8 co-operates with the part-spherical sheet-metal socket 6, to generate frictional resistance to pivotal movement of the device 3.

The end of member 8 remote from its head has a frusto-conically tapered surface 12 which co-operates with a complementary surface on an adjacent end of a tubular friction member 11 which also surrounds tube 2. The member 11 is radially compressible by being of plastics or similar material and has a plurality of slots extending alternately from one end, the other end being slightly less than the full length of the member 11. The surfaces 12 are such that when the spring 1 urges member 11 towards member 8, member 11 contracts to grip the tube 2 and tend to resist motion in proportion to the force exerted by spring 1 via its end cap 14. When cap 14 tends to move away from member 8, i.e. in expansion of the device 3, the member 11 expands, and there is little or no frictional damping. The frictional forces can be adapted to the conditions of use by varying the materials facing one another, their lubrication and the conicity of the aforesaid surfaces 12.

In Fig. 3 is shown a modified combined damping and suspension device whose operation is equivalent, but characterised in that, to increase the friction surfaces and to facilitate the dissipation of heat, the friction under load is applied to a larger diameter. In this device a compression spring 16 is disposed in a larger diameter tube 15 and its end remote from the tub carries a cap 17 having a frusto-conical tapered surface which engages a complementary surface of a friction member 19 engaging a lower cap 18 which has a part spherical portion accommodating a part-spherical head 20 of a mounting member 20 attached to a part 22 of the washing machine. Thus a multi-directional ball and socket joint is again provided.

At its other end the device of Fig. 3 has an attachment which comprises a helical tension spring 23 which is prestressed so that the turns thereof tend to engage each other. This spring 23 is embedded in a block 4 of elastomer such as resilient rubber or plastics material. Block 4 is adhered to rectangular plates of sheet metal 24 and 25. Block 4 acts to damp spring 23 and to muffle noises caused by the spring 23.

This elastic attachment allows lateral rocking movement of the end of the device adjacent the drum when forces are applied which are greater than the threshold predetermined by the prestress of the spring 23.

Fig. 4 shows a further modification of the combined damping and suspension device wherein again, as in Fig. 3, fructo-conically tapered surfaces on caps 27, 28 urge an expansible friction member 29 into engagement with an inner wall of a tube 26. The caps 27 and 28 also engage a strut extending from a base attachment of the device.

The device of Fig. 4 has, at its ends elastic attachments. At the base of the device the attachment comprises a tube 30 attached to the strut to extend transversely of its axis and an axle 33 is disposed centrally and co-axially thereof. The axle 33 is surrounded by a resilient sleeve 31 having a longitudinal

slot 31' and made of plastics material such as superpolyamide. Sleeve 31 is urged into frictional engagement with the axle 33 by an annulus of resilient elastomer 32 between sleeve 31 cylinder 30. The ends of axle 33 protrude from cylinder 30 and are mounted in a fork or clevis (not shown) on the machine frame so as to be incapable of pivoting. The frictional force between sleeve 30 and axle 33 resists pivotal movement of the device.

In a modification (not shown) the combined damping and suspension device can have an attachment as aforesaid at one end and an upper attachment at its other end directed perpendicularly thereto, for example of the kind shown in French Patent No. 1,152,307, the attachments having increasing resistance to flexing movement away from their positions of rest.

Figs. 5 and 6 illustrated a one-piece friction member which comprises a cylindrical portion 35 split longitudinally at 36, and having longitudinal grooves 37. The friction member has good radial elasticityand frustoconical surfaces such as 38, to facilitate radial expansion under the influence of complementary cups such as 27 or 17. The outer surface of the member can have radially disposed short textile fibres (advantageously threads of superpolyamide) resistant to wear in the presence of a lubricant. This generates an efficient friction zone 30, which also damps noise, the short fibres can be replaced by a piece of textile material.

Fig. 7 shows an end screw attachment having a screw 41 which is secured to a support 42 by a nut 43 and counternut 44. A head of screw 41 forms a knee joint 45 in a corresponding cavity of a collar 46 connected to an upper portion 47 of a combined damping and suspension device. The collar 46 is secured by crimping at 48. An elastomeric ring 49 is clamped between support 42 and collar 46, with a washer 50 of friction material between it and collar 46. The washer 50 can be replaced by a ring of flocking 51 if desired. The washer 50 or ring 51 acts to damp possible oscillation of the member due to the resilience of ring 49. A modification of this attachment is shown in Fig. 12.

Figs. 8 and 9, show a modified form of a base attachment of a damping and suspension device for a washing machine tub, which is formed in a single piece, either by stamping of metal, or by moulding or injection of plastics material. The attachment provides a longitudinal damping slide 52, and a lower cylindrical foot 53, which can co-act with a complementary attachment device on a frame of the machine and shown in Figs. 10 and 11.

The foot 53 can be replaced, for example, by a sphere or knee-joint, in combination with a complementary device on the machine.

The attachment device shown in Figs. 10 and 11 can be formed by two similar parts 54 and 55 which are made, for example, by moulding or injection of platics material and which are capable of being assembled in an inversely symmetrical manner, by the simple application of a fixing nut 56. Parts 54 and 55 clamp between them the foot 53, or a knee-joint, as has been described above, depending on whether it is desired to have a preferential orientation of articulation. In all cases frictional damping of the articulation is provided, which damping is variable and proportional to the bearing reactions involved.

The frictional surfaces can be lubricated with lubricants which are either "binary", combining zinc stearate and talc in equal proportions by weight, or "ternary", combining zinc stearate, talc and bisulphide of molybdenum in three equal parts by weight.

WHAT WE CLAIM IS:—

1. A washing machine having a tub supported by a plurality of combined camping and suspension devices extending between the tub and other structure of the machine, each said device being telescopic and including a compression spring, one end of which abuts a cap which engages a friction member, the cap and friction member having complementary tapered surfaces so abutting that when the spring urges the cap against the friction member said tapered surfaces co-act to urge the friction member into engagement with an adjacent surface to damp telescoping movement of the device.

2. A machine as claimed in claim 1, wherein the friction member is a one-piece resilient member split longitudinally.

3. A machine as claimed in claim 2, wherein the friction member has a cylindrical outer surface coated with a friction material.

4. A machine as claimed in claim 3, wherein each said combined damping and suspension device has at one end a foot with a complementary attachment device securing it to said other structure which is a frame of the machine, the complementary attachment device being formed by two similar parts which are assembled together in inversely symmetrical manner and united by a fixing nut, and which clamp the foot between them.

5. A machine as claimed in any preceding claim, wherein one of the ends of the device comprises a screw attachment having a knee-joint articulation with an elastic ring or bush, so as to clamp a friction washer in a transverse plane, to cause there frictional damping in a direction substantially perpendicular to that of the main longitudinal damping.

6. A machine as claimed in any preced-